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(54) Name of Invention: Oil Impregnated Electrical
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Specifications

1. Name of Invention

Oil Impregnated Electrical Machinery

2. Scope of the Patent Claims

Oil impregnated electrical machinery which uses an oil mixture in which 60% vol or greater rapeseed oil or soy bean oil, which are vegetable oils, is combined with alkyl benzene, as an electrical insulation oil.

3. Explanation of the Details of the Invention

Field of Industrial Use

This invention relates to oil impregnated electrical machinery which is, in terms of fire prevention, safer by means of use of an oil which is a less flammable electrical insulation oil.

The Hithertofore Technology

Hithertofore, alkyl benzene is used as electrical insulation oil (hereinafter referred to as

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insulation oil) for oil impregnated electrical machinery such as condensers, cables, transformers and such because it is superior electrical characteristics (has low loss, ability to withstand high voltage, gas absorption). Generally, alkyl benzene (hereinafter referred to as *AB*) is obtained by means of distilling dodecyl benzene, which has an alkyl group with an average carbon number of 12; there also instances wherein that from the slop from fractioning is mixed. Mainly that with the characteristics of *JISC2320* Class 2 (No. 1 ~ No. 4) is used as insulation oil.

The Problems This Invention Tries to Resolve

In recent years there has been a stricter than ever re-examination of the fire prevention policies for electrical machinery, and there is the need to make flame resistant the electrical machinery insulation oil used in oil impregnated electrical machinery. However, *AB*, unlike the previously used biphenyl chloride, is not inflammable; rather it is a flammable insulation oil. Use of biphenyl chloride was banned in the 47th year of Showa [1972] because of safety problems, and currently silicon oil is the only flame resistant insulation oil.

However, silicon oil (dimethyl silicon in accordance with *JISC2320* and such) has poor gas absorption, necessitating considerable lowering of the electrical potential gradient which is used; because of the increased size and increased price of electrical machinery, it cannot be used. Also, there is the idea of combining *AB*, which has superior gas absorption, but the gas absorption deteriorates.

Procedures for Resolving the Problematic Points

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This invention is that which seeks to offer oil impregnated electrical machinery which uses flame resistant insulation oil with improved flammability and with the gas absorption of the *AB* not lowered by combining rapeseed oil or soy bean oil, which are vegetable oils, with *AB*.

Embodiment

In the following, the details of this invention are explained based on the experiment data.

Because rapeseed oil and soy bean oil contain chain non-saturated hydrocarbons such as oleic acid, linolic acid, and linolenic acid (as an example, a chart of the component fatty acids is indicated), and gas absorption is superior.

Chart

	Rapeseed Oil (%)	Soy Bean Oil (%)
Palmitic Acid	4	10
Stearic Acid	2	4
Oleic Acid	55	22
Linolic Acid	22	54
Linolenic Acid	13	9
Others	4	1

Figure 1 is that which shows the gas absorption of each of the types of insulation oils; the gas

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absorption of rapeseed oil and soy bean oil is in the same class as that of *AB*.

On the other hand, the gas absorption of silicon oil is poor; it is actually a gas generating type.

The gas absorption of *AB* does not change even when rapeseed oil or soy bean oil is added.

Figure 3 is the combustion portion of the test flammability equipment used in the oxygen index method test; 1 is a glass column; 2 are the glass beads contained within the glass column 1; 3 is glass tubing with a 3mm inner diameter such that one end is housed with glass column 1, and the other end connected with the oil reservoir 4; this oil reservoir 4 and glass tubing 3 are filled with oil 5. The drain is 6, and it is connected with the glass tubing 3, with a cock 8 installed at the location of such connection. Also, 7 is a drain which is attached at the location of the oil reservoir 4. The flame is 9.

Figure 2 gives the results of the test which conducted by means of the oxygen index method in order to evaluate the flammability of the oil mixture resulting from the combination of *AB* with rapeseed oil or soy bean oil. The oxygen index method entails using oxygen and nitrogen with which to adjust the oxygen contained within the atmosphere of the combustion portion, and then to obtain the minimum oxygen concentration at which the insulation oil will ignite and continue to burn; it is a method in which that [concentration] is indicated as the oxygen index. It is used as the flammability test method for macromolecular material (*JIS K 7201*); shown in Figure 3 is a version of the measurement equipment modified for use with liquids was used in which the oxygen index for combustion and 3 minutes of sustained burn was measured. When rapeseed oil or soy bean oil is combined with *AB*, the oxygen index increases; when the ratio mix is about 60vol %, the oxygen index of the air becomes 21; it was determined that when the level goes beyond this, it tends to be combustion resistant and demonstrates self-extinguishing properties.

The upper limit of the combination ratio of the rapeseed oil or soy bean oil may be determined so as to obtain the appropriate kinematic viscosity of the oil mixture in light of the fact that the kinematic viscosity of these vegetable oils is higher than that of *AB*,

For the rapeseed oil and soy bean oil, those fulfilling the requirements of food grade level according to Article 29 and Article 23 of the *JAS* Standards is acceptable, but there is a general improvement in the electrical characteristics and increased total oxygen value when further purified with kaolin, activated aluminum, et cetera, and is that which can be used as electrical insulation oil with no problems.

Effect of the Invention

When rapeseed oil or soy bean oil, which are vegetable oils, is added to *AB* in the above manner at 60vol% ratio, a flame resistant electrical insulation oil which does not have the lower gas absorption and electrical characteristics of hitherto *AB* is obtained, and there is the effect of safer oil impregnated electrical machinery.

Also, these oils are edible oils, and needless to say, from a hygiene perspective, they are extremely safe materials.

4. Simple Explanation of the Figures

Figure 1 is a gas absorption characteristics graph of the insulation oil; Figure 2 is a graph of oxygen index, which indicates flammability, of oil mixture resulting from ratio in the combination of a vegetable oil with alkyl benzene; Figure 3 is an explanatory diagram of the combustion portion equipment used in the oxygen index flammability test.

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Figure 1

[please refer to the original for the graph]

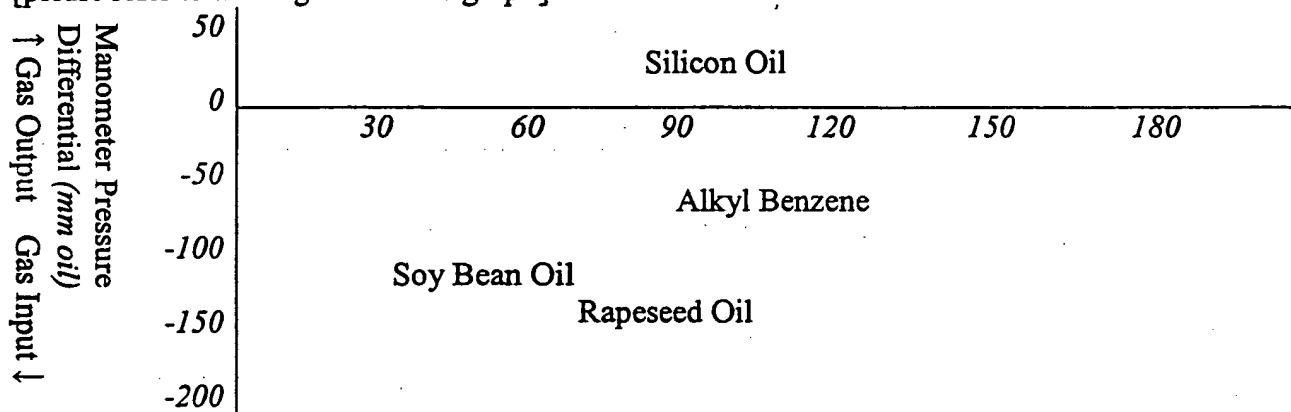
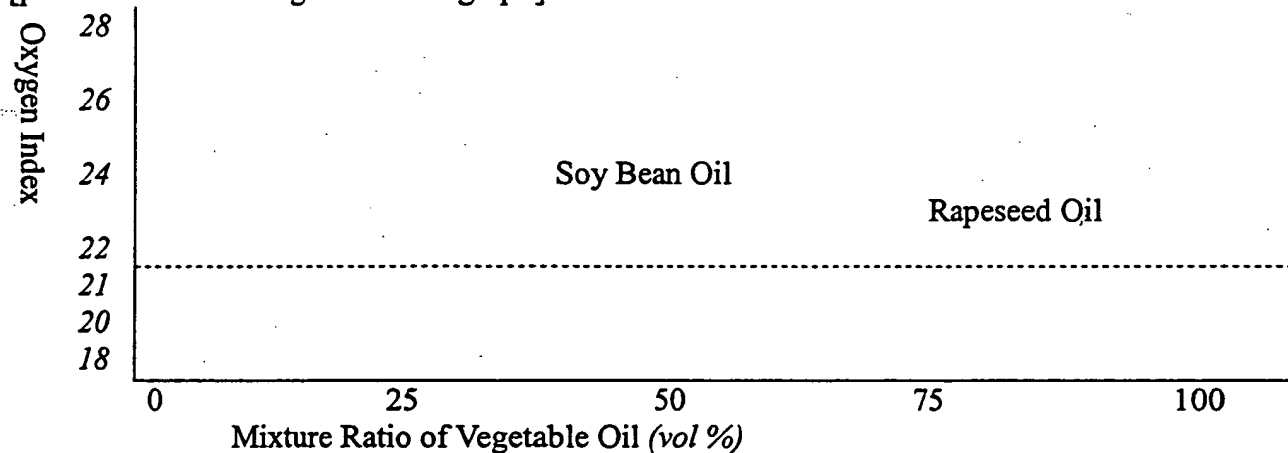


Figure 2

[please refer to the original for the graph]



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Figure 3

[please refer to the original for the drawing]

- 9 Flame
- 3 Glass Tubing (internal diameter 3mm)
- 7 Drain
- 4 Oil Reservoir
- 5 Oil
- 1 Glass Column
- 8 Cock
- 6 Drain
- 2 Glass Beads

N_2+O_2
↑↑↑↑↑↑

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[Translator's Note: The phonetic readings of the names appearing here (Shigeyoshi Nishikawa and Mikio Sawamura) are educated guesses. It is not possible to give a definitive phonetic reading of most names of individuals.]